SCIENCE

VOL. 90 FRIDAY, NOVEMBER 24, 1939 No. 2343

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SCIENCE: A Weekly Journal devoted to the Advancement of Science, edited by J. MCKEEN CATTELL and published every Friday by

THE SCIENCE PRESS

New York City: Grand Central Terminal

Lancaster, Pa. Garrison, N. Y.

Annual Subscription, $6.00 Single Copies, 15 Cts.

SCIENCE is the official organ of the American Association for the Advancement of Science. Information regarding membership in the Association may be secured from the office of the permanent secretary in the Smithsonian Institution Building, Washington, D. C.

HARVEY (WILLIAMS[1]) CUSHING

April 8, 1869–October 7, 1939

By Dr. ELLIOTT C. CUTLER

HARVARD MEDICAL SCHOOL AND PETER BENT-BRIGHAM HOSPITAL

Honour a physician with the honour due unto him for the uses which ye may have of him: for the Lord hath created him. For of the most High cometh healing, and he shall receive honour of the king. The skill of the physician shall lift up his head: and in the sight of great men he shall be in admiration.—*Book of Ecclesiasticus, Chapter 38, Verses 1–3. Being the First Lesson for St. Luke's Day.*

No other individual in modern medicine has revealed such a variety of accomplishments as Harvey Cushing: master-surgeon, neurologist, physician, critical investigator, medical bibliophile, inspiring teacher, litterateur, artist! His craftsmanship and technical performance in surgery were superb; his precise exploration of the nervous system made him an eminent neurologist; his care of and interest in his patients were an example for the most devoted family physician and brought to him the faith and love of patients above what is accorded most physicians; his curiosity led him to an interest in original sources and a love of books which resulted in his amassing a great medical library and becoming one of the leading medical historians of his day; his scientific medical contributions form an important background in neurophysiology and endo-

[1] The Williams, his maternal ancestor's name, was finally dropped after his settling in Boston in 1912, where his mail often became confused with that of a surgical colleague, Dr. Hayward Warren Cushing. But an even earlier episode had warned him of this difficulty, for in 1895 when he had taken the examination for house-pupil at the Massachusetts General Hospital, he failed to hear the result for a long time after the other candidates had been notified. Investigation revealed that his notice of successful application, which seemed all-important to him at that time, had been forwarded to the same Dr. Hayward Warren Cushing, one of the most promising younger surgeons of Boston. This first incident was probably a major influence in his dropping the use of his middle name in his publications as early as 1900.

crinology; his product in inspired and devoted pupils is exceptional; and his abilities as a writer both medical and otherwise are attested to by his being awarded the Pulitzer Prize in Letters for 1926.

Harvey Cushing was born in Cleveland, Ohio, on April 8, 1869, and died of coronary occlusion in New Haven, Connecticut, on October 7, 1939. He had long been a sufferer from peripheral vascular disease of the lower extremities and from gastric ulcer, disorders which he bore with a superb stoicism and courage. He is survived by his widow (Katherine Stone Crowell) and four children, Mary, Betsy, Henry and Barbara. William, another son, was killed in an accident while a student at Yale University in 1926. His first American ancestor, Mathew, landed at Hingham, Massachusetts, in 1638, and his ancestry contained a long line of doctor people whose roots were in New England. His great-grandfather, David (1768–1814), practiced medicine in Cheshire, Massachusetts; his grandfather, Erastus (1802–1893), was a teacher in the now defunct Berkshire Medical College; and his father, Henry K. Cushing (1827–1910), was the leading practitioner of his time in Cleveland, Ohio. During my years of residence in Cleveland (1924–1932) I often heard stories of both the ability and austerity of the father. His older brother, Edward, educated at Yale College, Harvard Medical School and the Massachusetts General Hospital, became in turn the leader of medicine in the Cleveland of his day. This brother was somewhat different from his forebears, more friendly and gregarious, loved by children, full of fun and, if the stories are correctly told, much like William Osler. And this brother was Harvey Cushing's direct stimulus and mentor. He took his brother Harvey on trips, talked to him about medicine, and filled him with aspirations and ideals. An early death robbed medicine of the full development of this older brother and Harvey Cushing of further influence from this source. This influence is attested to by the great admiration of the younger for the older brother, an admiration which endured throughout his life. Harvey Cushing liked to dwell on his brother's accomplishments and frequently spoke of his brother Ned's influence, when a house pupil at the Massachusetts General Hospital, in liberating the up-to-then starvation diet of the typhoid patient. It was apparent that the younger brother admired greatly the open and friendly nature of the elder brother and sought to emulate his characteristics. This emulation is seen again in his admiraton for Osler and others whose ease of personal contacts was of the same order. It is indeed a remarkable tribute to the breadth of Harvey Cushing's accomplishments and character that though similar traits were not his by nature, he actually did find time in his busy life for pleasantries and friendly contacts. These characteristics greatly endeared him to his young assistants and to his patients, and when in the later years the pressure of active clinical work had lessened they became more prominent and brought him hosts of youthful student friends.

From school in Cleveland he went to Yale College (A.B., 1891), and then to the Harvard Medical School (A.M. and M.D. *cum laude,* 1895). A study of Cushing's grades as found on his record in the dean's office at the Harvard Medical School is of some interest. The eleven A's and three B's are in sharp contrast to three C's, especially when we find the latter in therapeutics, clinical obstetrics and clinical surgery (C minus). However, one should know that at that time the curriculum provided only a minimum of clinical work and often the better men deserted class exercises and by their own initiative obtained experience at hospitals. We can easily imagine Harvey Cushing rebelling in the course in therapeutics at the very idea of committing to memory the doses and action of drugs which he foresaw he would never use. Indeed this record itself expresses his early intellectual independence. While still a senior at the Harvard Medical School, his brother Ned took him to Baltimore to visit the Johns Hopkins Hospital and Medical School, though it is dubious whether he met at that time either Halsted or Osler.

Following graduation from the Medical School, he was house officer on the South Surgical Service at the Massachusetts General Hospital. There his unusual abilities were in evidence and his hospital records represent the diligence, care, precision and artistic accomplishments which were soon to flourish and bear fruit. From Boston he went to the Johns Hopkins Hospital (1896–1900) to work under the beneficent influence of William S. Halsted. The shift from the Boston surgery of that day, where speed of operating was still considered advisable and even used as a gauge of ability, to the painstaking, slow and gentle methods of Halsted was an everlasting inspiration to the pupil Cushing. He often told the story himself that, coming from Boston where a complete breast procedure was accomplished in twenty-eight minutes, he saw with misgivings a four-and-one-half-hour operation for the same undertaking. How amazed he was that stimulants were unnecessary and how horrified he was when told not to dress the wound for ten days! Recalling the wounds he had previously studied, he remarked to himself: "I may not see the wound, but I will smell it!" When in ten days the wound was dressed and found perfectly healed, his skepticism disappeared. Moreover, here he was first introduced to the experimental method, was taught the value of careful and detailed records whether in the laboratory or on the ward. From Halsted he learned that precise and thorough concentration on a small problem might yield more than great labors in routine work. Here, too,

he learned the value of a meticulous and gentle technique that sought to spare each cell from being damaged, a technique which was to permit him later to create the surgery of the central nervous system. It is doubtful if Halsted had any other pupil who learned so rapidly and thoroughly the art of surgery as he, Halsted, conceived it.

Finally, his training as a general surgeon completed, Dr. Cushing went abroad (1900–1901), and in Berne through Kocher and Hugo Kronecker accomplished his first work in experimental neurology ("Physiologische und anatomische Beobachtungen über einige hiermit verwandte Erscheinungen." *Mitt. Grenzgeb. Med. Chir.*, 9: 773–808, 1902). This neurological field was to become his life work, and it is of interest to examine the stimulus which brought him to it. My notes made after conversations with Dr. Cushing led me to feel that Dr. Halsted suggested to him the field of neurological surgery, but recently Dr. Roy McClure, who worked with Dr. Cushing during the first year that the Hunterian Laboratory was open and who later became Halsted's resident surgeon, and others have made it certain that Harvey Cushing himself proposed the field to Dr. Halsted. Dr. Halsted's first reply was, "Why, Dr. Cushing, we had only two cases of brain tumor last year!" When Dr. Cushing persisted, Dr. Halsted remarked, "All right, the field is yours." And perhaps there were indications of this leaning even earlier, for the title of Dr. Cushing's second paper was "Haematomyelia from Gunshot Wounds of the Spine. A Report of Two Cases, with Recovery Following Symptoms of Hemilesion of the Cord" (*Amer. Jour. Med. Sci.*, 115: 654–683, June, 1898). This article was spoken of by Dr. Thomas, then professor of neurology at the Johns Hopkins Medical School, as the best investigation of superficial sensory supply carried out up to that time. In addition Osler may have influenced him in this selection. Speculation is incited when we know that Dr. Cushing, while a surgical interne at the Massachusetts General Hospital, had written to Dr. W. S. Thayer to ask if there might be an opening for him on Dr. Osler's staff. This letter to Thayer was never answered, and one can only imagine the consequences had this application received an affirmative answer!

During this early trip to Europe, Dr. Cushing also met Sherrington in Liverpool and in Pavia, Italy, picked up a clinical model of Riva-Rocci's blood pressure apparatus with inflatable armlet which he adapted for use in all his subsequent surgical procedures. The charts on which such records were kept represent the first anesthesia charts, though it should be known that Amory Codman and Harvey Cushing had a wager when house pupils at the Massachusetts General Hospital (1895) as to who could anesthetize without subsequent vomiting and kept records for this purpose. Their pioneer efforts to chart a patient's condition properly throughout a surgical procedure are now bound together in the Record Room of the Massachusetts General Hospital as evidence of a beneficent change in which the youngest members of a hospital staff played a rôle. This effort did not originate with these young men, but represented a desire of their visiting surgeon, Dr. Harrington, and was actually in use before Harvey Cushing went on service.

On his return from Europe, Cushing became the neurosurgeon of the Johns Hopkins Hospital group. It was a difficult and discouraging beginning. The mortality was terrific, though better than that obtained by other surgeons. Always there was extreme diligence and thoroughness. Autopsies were secured whenever possible. The reasons for catastrophes were thus explained and technical perfection thus secured. The happier field of the surgical treatment of trifacial neuralgia was reopened, studied and made safe. Laboratory efforts previously in the field of general surgery continued in this newer field, and soon he began to investigate the pituitary body. Tumors of it were studied; investigation of its functions grew apace; and by the time of his removal to Boston, his first book appeared, "The Pituitary Body and Its Disorders. Clinical States Produced by Disorders of the Hypophysis Cerebri. An amplification of the Harvey Lecture for December, 1910" (J. B. Lippincott Company, Philadelphia and London, 1912).

These formative years in Baltimore, when his work hardened entirely along neurophysiological lines, were the years when he discovered in William Osler a chief stimulus and mentor. They were next-door neighbors, and his footsteps were often turned to Osler's home, where he found the encouragement, guidance and leaven which only such a brilliant character could give. Here he began to acquire his love of books and his amazing information in the background of medical history. Here he gathered in acquaintances from many corners of the world to emerge a real cosmopolitan. Osler's departure to Oxford in 1905 seemed a great loss to Harvey Cushing, but by this time he was well started in his bibliophilic adventures and perhaps was really benefited by the independence of thought and action which this separation enforced. Anyway, the trail between these two was now well established and their correspondence formed a major tie of interest for each until Osler died.

In 1910 he was simultaneously appointed professor of surgery at the Harvard Medical School and surgeon-in-chief to the Peter Bent Brigham Hospital. It is clear that the trustees under the will of Peter Bent Brigham, who had died in 1877, had at last decided that the time was ripe to construct the hospital, which the donor had specified was to care for "sick persons in indigent circumstances residing in the County of

Suffolk." The new Harvard Medical School had been opened in 1906, and one can visualize the wise heads that brought together the Harvard authorities and the Brigham Hospital trustees. But it was not until August, 1911, that ground was actually broken, on a cow-pasture adjacent to the new Medical School, and the construction of the hospital was only partly finished when Dr. Cushing with his family moved to Boston in the summer of 1912. At this time his Medical School title was changed to that of Moseley Professor of Surgery, the position in surgery previously filled by Maurice Richardson. Now he began to organize his work in the Harvard Medical School laboratory and in the partly constructed hospital, which was to open its doors in January, 1913. The appointments of David Cheever and John Homans to the senior staff gave to the new hospital the most promising of the junior surgeons of Boston of that time, and his house staff, largely composed of Johns Hopkins men, contained a few Harvard graduates of the class of 1913.

Soon the work was in full swing, and the details of his accomplishments at the Brigham Hospital are readily accessible in the Annual Reports of the hospital. It is appropriate to point out here that Harvey Cushing and his colleague Henry Christian, put great emphasis on the value of professional hospital reports. Here they reviewed and prophesied the changing character of both medical education and medical practice and thus elevated hospital reports to a useful professional level. At first he kept his interest in the general surgical clinic, but his prominence in neurosurgery was so outstanding that gradually this field occupied all his energy and time. That his primary interest lay in neurophysiology and neurosurgery is perhaps better reflected in the laboratory efforts of his full-time assistants, which began with the work of Lewis Weed, his first Arthur Tracy Cabot fellow,[2] whose important contributions to the cerebrospinal fluid circulation appeared in 1914. Yet, in spite of these responsibilities, there was at first time for tennis and frequent discussions with the devoted members of his house staff. Indeed it was these informal meetings plus his weekly rounds on patients with other than neurological disorders and the influence of his great example in the care of his own neurological patients which permitted him to be the major influence for many years to come on many pupils whose interest lay in the field of general surgery. And from time to time he did take on the performance of some unusual task in the field of general surgery, and such procedures will long be remembered by the internes of the first few years of the Brigham Hospital as among their greatest moments of inspiration. Before the Great War was upon us, he had become one of the leading surgeons of our day, a matter attested to by the invitation to give the oration in surgery at the International Congress of Medicine in London in 1913, "Realignments in Greater Medicine; Their Effect upon Surgery and the Influence of Surgery upon Them." (*Brit. Med. Jour.* 2: 290–297, August 9, 1913. Also: *Lancet,* 2: 369–375, August 9, 1913.)

Then came war, and for Dr. Cushing two experiences, one with the French Army at the American Ambulance Hospital in Paris, April, 1915,[3] and later, after the United States had entered the war, with Base Hospital No. 5 in France, May 1917–May, 1919. His great abilities soon led to his removal from this Base Hospital group, of which he was the organizer and peace-time director, to become the senior consultant in neurosurgery of the American Expeditionary Force. During these experiences his tremendous labors under the severe physical strain of forward conditions brought comfort and life to many an injured soldier, but his unsparing devotion to the task eventually undermined his health and left him a sufferer from arterial disease for the remainder of his life. All through this period of immense physical strain, his publications continued. His contributions to the care of intracranial war-wounds set the proper methods in this field. Great as was his devotion to professional work, he found time to keep up his daily "Journal," a habit begun in youth and continued throughout his life whenever he traveled away from home. In 1936, excerpts from his daily "War Journal" appeared in book form, "From a Surgeon's Journal" (Boston: Little, Brown and Company, 1936). For his great works in France he was honored by his own country by the award of a "Distinguished Service Medal," by Great Britain by the Order of the "Companion of the Bath" and by France with the position "Officer of the Legion of Honor."

During this war experience there were several trips to England and each time the long-desired visits with Osler. On one of these occasions the writer was present and recalls as brightly as if it were but yesterday the witty and brilliant chaffing which flowed forth at

[2] This fellowship was endowed through the generosity of Dr. and Mrs. F. C. Shattuck in honor of Mrs. Shattuck's brother, who had been a leading surgeon in Boston and a visiting surgeon at the Massachusetts General Hospital when Harvey Cushing was a house-pupil.

[3] At the outbreak of the European War Americans in Paris organized the American Ambulance Hospital under the auspices of the American Hospital, a small incorporated hospital largely used by the American colony there. The French Government placed the new Lycée Pasteur in Neuilly at the disposal of this new Ambulance Hospital. One of the three services was organized to be staffed by groups which rotated every three months from American Medical School Hospitals. A unit under Dr. George Crile from the Lakeside Hospital, Cleveland, Ohio, began this service on January 1, 1915; the Harvard Medical School unit followed, April–June, 1915, and was in turn followed by a unit from the University of Pennsylvania Medical School. Dr. Cushing remained with his unit only for the month of April, 1915, returning via England, where he visited Sir William Osler.

the time. It was shortly before Revere Osler's death, and though the imminence of disaster seemed in the very air, the comfort and happiness of the guests was overwhelming. Conversation this time drifted from the first written medical document, a piece of stone covered with unknown writing, to how difficult it was for the British to learn the value of corn as food for man, having for centuries thought it fit only for pigs and chickens! All the time Harvey Cushing sat wrapped in devoted and appreciative silence.

After the war he became reestablished in Boston, and his labors in neurosurgery took on their final form. His interest in general surgery lagged, for there was no time for it. Assistants flocked to his side to work in neurology and neurosurgery, and the output of their work and influence is world-wide. In the midst of all this William Osler died, and at the request of Lady Osler he took up the writing of a biography. It was a labor of love, but it was accomplished with the same tools and vigor that surrounded all Harvey Cushing's works. First every possible source of information was gathered in and digested, the smallest references in daily newspapers were consulted and from this background the great two-volume biography appeared. Small wonder to those who knew of the sincere efforts that the product would be so universally acclaimed.

On the occasion of his sixtieth birthday, 1929, his pupils dedicated to him a collection of their writings. This "Festschrift" special number in honor of Harvey Cushing's 60th birthday; (*Arch. Surg.*, 18: 935–2045, 1929) emphasized his qualities as a teacher. The eighty-two papers were contributed by men then holding some of the most important medical and surgical positions not only in the United States of America but in Europe. And the contributions not only were in the field of neurology and neurological surgery but ranged over the entire field of medicine and included historical essays as well as experimental and clinical observations. The impact of Cushing's character and abilities is nowhere better pictured than in this affectionate tribute.

His effect upon the Harvard Medical School Faculty was considerable, even though he and the dean of the school during this period did not always agree in matters of policy and action. Cushing was greatly interested in the establishment of a common library, in the modification of the curriculum with its resultant reduction in didactic hours and was a leader in opposing the adoption of the "full time clinical teaching" in the strict Rockefellerian sense and in opposing a plan that the Medical School edit a text-book which purposed to infiltrate all departments of the school with preventive medicine.

The hospital regulation set by himself and Henry Christian automatically retires the professional members of the Brigham Hospital staff at 63, and this by custom is accompanied by resignation from the Medical School appointment. And so in 1932 arrived the date of retirement set by himself. It came at a time when Dr. Cushing was working as never before, though bothered with peripheral vascular disease and the signs and symptoms of gastric ulcer. The transition from his tremendously active life was great, but he made it abruptly, and surgery was given up. He refused the repeated requests of the Brigham Hospital trustees to remain in service as surgeon-in-chief, and attempts were soon made to entice him to many places, though it was hoped he would stay in Boston and work on his collection of brain tumors. He remained at the hospital for another year, however, and worked in uncomfortable quarters, for he insisted that his successor occupy immediately the quarters set aside for the surgeon-in-chief. The following year he went to Yale as the Sterling Professor of Neurology (1933–1937). Here he was offered an active post, not simply an honorary sinecure, and to a man in the full vigor of his years this opportunity and his natural devotion to his alma mater, which had the vision to utilize his great abilities, turned his footsteps away from Boston and Harvard. With him went his collection of brain tumor specimens and photostatic copies of the patients' records. At Yale he continued a thorough study of this great mass of material, the assembling of which represented such unusual physical efforts. Major fragments of this material had appeared either in book form, as the monograph on the acoustic neurinomas (1917) and the classification of the gliomata with P. Bailey (1926) or in separate smaller publications, notable among these being his final contribution in the field of pituitary disorders, "basophilism," a clinical syndrome which now bears his name. At Yale, the work continued in spite of frequent physical discomforts. Clinical, experimental and historical papers continued. But chiefly there was the continued study of his own experiences in the field of brain tumors, and always there went on the end-result letters and follow-up examinations.[4] Though the Yale professorship terminated in 1937, the work continued unabated, and he was as active from 1937 up to the time he died as at any time in the last five years. The great volume on the meningiomas did not appear until 1938.

On the occasion of his seventieth birthday, his publications were listed in book form ("A Bibliography of the Writings of Harvey Cushing, prepared on the occasion of his seventieth birthday, April 8, 1939, by

[4] As late as July, 1939, a chromophobe pituitary adenoma patient seen first by Dr. Cushing in February, 1926, turned up at he Brigham Hospital to show the writer a letter from Dr. Cushing inquiring about his condition with the request that the writer examine him and send the information to Dr. Cushing. This done, there was the immediate grateful reply, so characteristic of his correspondence with a pupil.

the Harvey Cushing Society." 1939. Charles C Thomas.)

The major books are:

"The Pituitary Body and its Disorders. Clinical States Produced by Disorders of the Hypophysis Cerebri." An amplification of the Harvey Lecture for December, 1910. Philadelphia and London: J. B. Lippincott Company, 1912.

"Tumors of the Nervus Acusticus and the Syndrome of the Cerebellopontile Angle." Philadelphia and London: W. B. Saunders Company, 1917.

"The Story of U. S. Army Base Hospital No. 5. By a Member of the Unit." Cambridge, Mass.: University Press, 1919.

"The Life of Sir William Osler." Oxford: At the Clarendon Press, 1925.

"A Classification of the Tumors of the Glioma Group on a Histogenetic Basis with a Correlated Study of Prognosis." (With P. Bailey.) Philadelphia, London and Montreal: J. B. Lippincott Company, 1926.

"Studies in Intracranial Physiology and Surgery. The Third Circulation. The Hypophysis. The Gliomas." London: Humphrey Milford, Oxford Press, 1926.

"The Pathological Findings in Four Autopsied Cases of Acromegaly with a Discussion of their Significance." (With L. M. Davidoff.) New York: Rockefeller Institute for Medical Research (Monograph No. 22), 1927.

"Tumors Arising from the Blood-Vessels of the Brain. Angiomatous Malformations and Hemangioblastomas." (With P. Bailey.) Springfield, Ill.: Charles C Thomas, 1928.

"Consecratio Medici and Other Papers." Boston: Little, Brown and Company, 1928.

"Intracranial Tumours. Notes Upon a Series of Two Thousand Verified Cases with Surgical-Mortality Percentages Pertaining Thereto." Springfield, Ill.: Charles C Thomas, 1932.

"Papers Relating to the Pituitary Body, Hypothalamus and Parasympathetic Nervous System." Springfield, Ill.: Charles C Thomas, 1932.

"From a Surgeon's Journal 1915–1918." Boston: Little, Brown and Company, 1936.

"Meningiomas. Their Classification, Regional Behaviour, Life History, and Surgical End Results." (With L. Eisenhardt.) Springfield, Ill.: Charles C Thomas, 1938.

The addresses, papers in journals and reports number three hundred and five and, though largely in the field of neurosurgery, neurophysiology and endocrinology, include a large leaven of historical items of great importance.

Honors came to him in profusion. He held twenty-three honorary degrees, and honorary fellowships, membership or corresponding membership in most of the medical societies of the world. He was a past president of the American College of Surgeons, 1922, the American Neurological Association, 1923, and the American Surgical Association, 1927. These honors seemed to please Harvey Cushing, and particularly one of the last he was to receive. He crossed the Atlantic as late as 1938 to receive the degree, doctor of science, "honoris causa," from Oxford.

Death came through coronary disease; first a severe attack that necessitated hospital care and three days later final rest. It came after seventy years of fruitful, vigorous labors for the good of others. The end was perhaps foretold in his long-standing suffering with peripheral vascular disease, which for twenty years gave him great discomfort, though this was known only to his intimates.

It is difficult to analyze and estimate Dr. Cushing's accomplishments, for he reminds us of the great characters of the Renaissance, such as Leonardo da Vinci, who achieved success in many fields. However, Dr. Cushing's accomplishments seem to flow from a single characteristic. This was his *extraordinary capacity for sustained work*. By nature he was essentially a *perfectionist* and *an aristocrat*. Everything was good or bad; there was scant room for mediocrity or in-betweens. His naturally artistic temperament made his technical surgery a work of art, and his abiding desire for accuracy and perfection brooked no compacts with mediocrity. Behind this craving for accomplishing everything that came to hand in a complete and artistic fashion, lay his enormous energy. It was as if he he had a dynamo within him which was unaffected by use. This is visualized better in his unseen activities, the writing of his journal each night, the hours spent in reading pupils' manuscripts, the immense breadth of his bibliophilic forays, only meagerly reported, rather than in his physical labor at the operating table or the publications for which he is so widely known.

A further natural characteristic was his *insatiable curiosity*. He was not content to see something; he must know all about it. This was revealed as well with books as with patients. Thus when he acquired a new book, he was not content just to read the book and show it to others; he had to know all about the man who wrote it, all about the previous owner, about the press it came from and the other works of the printer. Thus an incidental purchase evoked a tremendous labor. And it went on daily.

It would be presumptuous for a pupil to attempt to assay fully the character and qualities of his master, and praise would be an impertinence. We who have benefited so greatly from his teachings and his example can only be happy that the privilege was ours to be near him. I am one of those who will always feel that here was a man who lived completely for the medicine of his day. Everything he touched he made better. His opening up of the field of neurosurgery was but a small part of the man, for this accomplishment, just as his amassing a great library, his knowledge of medical history, his exquisite ability as a writer and

splendid laboratory contributions all flowed from basic desire to do the best he could for suffering humanity. Of no other has it ever been more correctly said that he "lived this life up to the hilt."

And what will the patients say? Miss Ida Cannon has told me of the reaction of a patient with Raynaud's disease at the Massachusetts General Hospital when Harvey Cushing was a house pupil (1895). The patient, a bandage on her foot, had viewed with alarm the abrupt approach of the young man in white with a large pair of scissors which she anticipated meant amputation then and there. She related how the first dressing and all others which followed were accomplished with exquisite gentleness and care. She remained a worshipful patient at this same shrine all her life. How could it be otherwise? Never was there a better doctor in the real sense of the word. Everything that had to do with a patient was vitally important, the position in bed, the pillows, the daily bowel movement, the removal of the sutures all assumed equal importance with the surgical operation itself. Here was what sickness needed—complete understanding, great patience and exquisite gentleness.

As I try to look back over a quarter of a century and view not only the immense works but also his effects as a teacher, the latter seems very simple. Harvey Cushing taught by example. He never asked any assistant to work as hard as he did. It was the age-old method of apprenticeship. He hated class exercises and disliked lectures. If there was a patient, it was all right and he would let the class draw their own conclusions. His house staff learned chiefly from his example, certainly the internes did. When one had climbed further up the ladder, either in his clinic or in the laboratory, it was different. The master and pupil met there more or less as equals trying to settle matters. It was natural that Dr. Cushing's curiosity, when coupled with a primitive desire for perfection, should sprout problems daily and many a casual conversation with a member of the house staff ended with the beginning of a new series of investigations.

Little wonder that such an ardent and serious person was impatient with incompetence and slovenliness. It has been said that Harvey Cushing was a severe taskmaster. He was when it was necessary. There is no place for half-heartedness and mediocrity when one deals with life. No effort can be too great if it can be of assistance. Those who worked longest with Dr. Cushing came to admire and love him best, for they knew the depth of feeling and vision behind the critical remarks. Moreover, criticisms were always accompanied by the vision of a better way the next time. And it was not all stern and cold. There were many sympathetic and generous moments. His little kindnesses were not only to the old and devoted pupil, they came often to total strangers in his path. A distinguished surgeon of to-day has recently related to me his early contacts wih Dr. Cushing. He as a young surgeon had spent a month watching from the operating room seats or on ward rounds. But practically no contact had been made. Suddenly, one Saturday morning, Harvey Cushing summoned him: "Here, take this seat to the Harvard-Yale football game!" A moment later, as our friend stood abashed by this sudden offer, "Have you rubbers?" "No." "A raincoat?" "No." "Go down and tell my secretary to give you mine." It was that rainy day of 1923 when "Ducky" Pond derived his pseudonym, acquired a fumbled ball and waddled down a marshy field for a touchdown! And this story had its counterpart many times.

There is no doubt in my mind that Dr. Cushing disliked elaborate functions, and was happiest when at work. Moreover, he wanted to become acquainted with all the people about him and therefore rather frowned on big institutions feeling that there the effect of the master would be either lost or so attenuated there would be little productivity. His devotion to the apprentice system (Hippocratic, he called it) of teaching medicine was well recognized in the Harvard Faculty, where he opposed any movement in medical education that in any way robbed the student of opportunities to meet a teacher at the bedside of a patient.

This method of teaching was the only one Harvey Cushing ever concerned himself with. The author was secretary of the Department of Surgery during an early part of this period and recalls the impossibility of interesting Harvey Cushing in any part of the surgical curriculum which had to do with class efforts. On the contrary, he fought hard in his department and on the floor of the Faculty Room for any change that brought the student and the teacher together at the bedside of sick people. Nor is it difficult to understand this attitude of Harvey Cushing's toward education. He had previously experienced the value of study and independent work, and at the Johns Hopkins Hospital and Medical School this personal experience had been intensified by the methods of teaching so brilliantly successful in that school. Halsted had demonstrated to him the experimental method and had allowed him great latitude in acquiring experience in technical surgery. As a result Cushing would trust his own five senses above laboratory methods and the teaching of others. Moreover, his natural scepticism encouraged the accumulation of personal experience as a chief road to education. Thus he insisted on others acquiring their information through a similar system and method.

Other than this emphasis on education through self-experience, Cushing's influence as a teacher was essentially that of teaching through example. He utilized fully the stimulus which comes through per-

sonal contacts and emulation. As a rule, a man of few words, he produced his effect on his pupils by virtue of his example. He lived for and by work, and to those privileged to associate themselves with him he was as stimulating and instructive a master as there could be. This influence, by the very reason of its method, was a restricted one and produced its chief results among his immediate assistants in the Brigham Hospital and in the Laboratory of Surgical Research of the Harvard Medical School. Such an influence could not permeate the entire student body and though his amphitheater clinics were well attended, there were many students who failed to appreciate his historical embellishments and even avoided his exercises except when they covered the nervous system or the ductless glands, in which fields he was so obviously a leader. But within the hospital walls it was different. Here the young assistant saw and recognized at once two great attributes worthy of constant emulation. First, the perfection of his technical methods. Nowhere else could he see such exquisite handling of tissues; in no other clinics did wounds heal so kindly, nor such dangerous procedures go forward with such little difficulty, moribidity and mortality. Secondly, the pupil envisaged the perfect care of the patient; the unsparing efforts to provoke confidence and comfort; the value of thorough records and their proper use. He was taught that no detail which added either to the information about the patient or to the comfort of the patient could be neglected.

Harvey Cushing's life is ended. His great accomplishments are known wherever civilization flourishes and will pass down the ages to benefit the generations to come. He became a chief decoration of every institution he served, brought great merit to them and assisted many young men to assume a way of life certain to bring comfort and happiness to humanity. He himself would like most to be remembered as one who upheld the first tradition of our profession—let nothing be neglected that can benefit a patient! This was his "vade mecum" and made him stand out as a chief physician of his time.

THE PRESENT STATE OF SOLAR ACTIVITY AND ASSOCIATED PHENOMENA

By Dr. HARLAN T. STETSON

MASSACHUSETTS INSTITUTE OF TECHNOLOGY

THE rise in solar activity recently reported in SCIENCE[1] has been accompanied by changes in the electrical state of the earth's atmosphere made evident by numerous displays of aurorae and ionospheric disturbances affecting radio transmission. While many sunspots have been conspicuous during the last few months, a study of the sunspot numbers during the last few years shows that the actual maximum occurred in 1937. The graph of sunspot numbers from the minimum of 1933 to date printed herewith (Fig. 1) shows the present state of solar activity with respect to the maximum so recently passed.

The curve has been drawn through individual monthly values derived by taking the moving averages of three months at a time. Inspection will show that the highest three months average occurred in July, 1937, with a Wolfer index of 137. It will be noted that this high was followed by an abrupt drop to the end of the year, with a recovery in 1938 to a three-months high of 131.6 centering in June of last year. The subsequent rise during the early part of this year yielded an index of 111 centered about May, 1939. The maximum passed in 1937 was the highest since the maximum of 1870, when the corresponding Wolfer solar index stood at 165.

The rapid decline in the sunspot numbers during the early part of October indicates a decreasing activity for the next six months and that the major trend will be definitely downward for the next four or five years. The next minimum may be expected to fall in 1943 or 1944.

In reviewing the activity of the sun in recent years, it is interesting to note that the interval between the last two maxima—that of 1928 and that of 1937—has been but nine years, as compared with the mean interval between maxima usually taken as 11.2 years. This is the shortest interval between maxima for over a century. Had we attempted to predict the present maximum by adding the 11.2—year average interval to the last maximum, we should not have expected the present period of heavy solar activity until 1940.

At a meeting of the American Association held at St. Louis in 1935, I ventured to predict on the basis of sunspot activity at that time that the next maximum would occur at the end of 1937 or the very early part of 1938. On the basis of the sun's performance during the subsequent four years, it would appear that the sun anticipated even this prophecy by possibly six

[1] SCIENCE (Supplement), 90: 2337, 9, October 13, 1939.

[2] John Q. Stewart and H. A. A. Panofsky, *Astrophysical Journal*, 88: 4, 385–407, November, 1938.

[3] Newbern Smith, Theodore R. Gilliland and Samuel S. Kirby, National Bureau of Standards Research Paper RP1159, Vol. 21, December, 1938.

months. However, if the top of the curve is smoothed to eliminate the secondary fluctuations, it would appear that the mid-maximum falls very near this predicted time.

The irregularities in the so-called sunspot cycle have presented many difficulties from the point of view of prediction. Attempts to forecast solar behavior on the basis of harmonic analyses of many years of sunspot data have frequently brought disappointing results when projected into the future. Astrophysicists acquainted with the irregular variations in many stars of unpredictable performance have come to believe that no combination of fixed periods can ever safely be used for predicting the future of solar behavior.

FIG. 1

Abandoning Newcomb's conclusion "that an underlying regularity of period governs the sunspot cycle," J. Q. Stewart and Panofsky[2] have recently made a mathematical analysis of 16 solar cycles from the point of view of the "outburst" hypothesis of Halm and Waldmeier and have derived an expression for the sunspot number R for each given year after an observed minimum. Their quantity R depends upon the general form of the family of curves that appears to be typical of the rise and subsidence of sunspots once a new period of solar activity has started. On the basis of such short-range prediction they have derived an average sunspot number for 1937 as 114.4 agreeing closely with the actual observed value of 115.1.

Still holding to the principle of underlying periods, H. H. Clayton three years ago predicted the date of the coming maximum of sunspots to be 1937.5, a value in extraordinarily close agreement with the subsequently observed data. In making his forecast, Mr. Clayton purposely avoided using any observed data subsequent to 1910 to test the validity of his prediction. The desirability of even short-range prediction of solar activity is coming to be of increasing importance, due to the many now recognized ionospheric changes that parallel so closely the solar cycle.

Among the generally recognized phenomena of a terrestrial nature that show changes with the sunspot cycle, the most obvious are the auroral displays such as have been unusually active during the last two years. Through the courtesy of Director C. H. Brooks, I have examined the records of the Blue Hill Observatory, which have been kept since its inauguration in 1885, and find a very marked tendency for the maximum frequency of brighter aurorae to occur on the average about a year after sunspot maximum (Fig. 2). In treating the data the number of aurorae for a given year was weighted with the observed intensity and the moving averages of three consecutive yearly values taken in plotting the curve.

The delay in the maximum of auroral frequencies with respect to the sunspot maximum calls for some explanation. Differences of opinion exist as to the exact mechanism connecting solar activity with auroral phenomena. Some investigators believe that the ionization responsible for the displays of the polar lights is produced by bursts of ultra-violet light from the sun accompanying the period of maximum solar activity. Dr. Carl Störmer, on the other hand, favors,

the hypothesis that corpuscular emission of some sort emanates from sunspot centers and has been remarkably successful in computing the actual forms of auroral streamers on the basis of the behavior of charged particles coming from the sun and entering the upper atmosphere along paths distorted by the magnetic field of the earth.

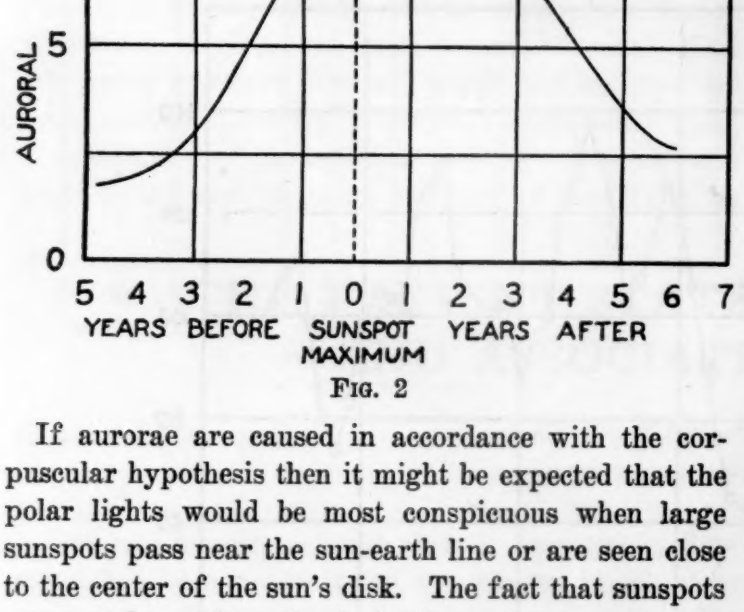

FIG. 2

If aurorae are caused in accordance with the corpuscular hypothesis then it might be expected that the polar lights would be most conspicuous when large sunspots pass near the sun-earth line or are seen close to the center of the sun's disk. The fact that sunspots occur at decreasing solar latitudes as the sunspot cycle progresses suggests that as the more active spots approach more nearly the solar equator they will more frequently cause brilliant aurorae. It should be possible on the basis of more complete data of the last few years to analyze the occurrences of aurorae with respect to the positions of sunspots near the central zone.

By the time spots begin to appear within 5° of the sun's equator, the numbers of sunspots have so appreciably waned as to diminish very considerably the presumable cause for auroral phenomena. Even on the hypothesis of flares of ultra-violet associated with chromospheric eruptions in the vicinity of sunspots, one would expect the latitude effect to be important in the production of aurorae. In either case, therefore, we have a possible qualitative explanation for the maximum in auroral frequency occurring after the actual maximum of sunspot numbers has been passed.

Since it is evident that an increased emission of ultra-violet radiation from the sun and possibly also the emission of particles in the vicinity of sunspots are directly associated with increased ionization of the earth's upper atmosphere, the phenomena of radio transmission may be expected to show variations with solar activity. Field strength measurements of a Chicago broadcasting station made at our suburban laboratory have shown a decrease from a value of more than 300 microvolts per meter at the sunspot minimum of 1933 and 1934 to a value of about 100 microvolts per meter during 1938. Sunspot numbers for the same interval rose from an average of 5 to an average of around 120. Critical frequencies for penetrating the E layer as published by the Bureau of Standards[3] have shown likewise a consistent parallel with the last four-year rise in solar activity, the value rising from 3.05 megacycles in 1934 to 3.75 megacycles in 1938.

Well-known changes in the intensity of the earth's magnetic field following closely changes in sunspots have been recognized for over 100 years. It is now obvious that probably the major contributing factor in the geomagnetic fluctuations is to be found in the ionization changes in the upper atmosphere. Developments in radio technique, therefore, offer new tools for exploration in unlocking the relationship between solar activity and terrestrial, atmospheric and magnetic phenomena.

SCIENTIFIC EVENTS

A DISCUSSION OF FRANKLIN AND HIS TIMES

A DISCUSSION of Franklin and his times entitled "Meet Doctor Franklin" is being held under the auspices of the Franklin Institute with the cooperation of the American Philosophical Society and the Historical Society of Pennsylvania.

The conferences are being held on Fridays at 5:15 P.M., beginning on October 20 and ending on April 19. The program follows:

Opening address, Dr. Carl Van Doren, author and editor, New York City.

"The Philosophical Revolutionist," Bernhard Knollenberg, librarian, Yale University.

"Dr. Franklin: Friend of the Indians," Dr. Julian P. Boyd, librarian and editor, Historical Society of Pennsylvania.

"The Colonies and the Mother Country," Dr. Verner W. Crane, professor of American history, University of Michigan.

"The Diplomat," Dr. Frank, Monaghan, assistant professor of American history, Yale University.

"Self-Portraiture: The Autobiography," Dr. Max Farrand, director, Huntington Library, San Marino, Calif.

"Looking Westward," Professor Gilbert Chinard, professor of French, Princeton University.

"Molding the Constitution," George Wharton Pepper, member of the Franklin Institute, Philadelphia.

"The Printer at Work," Dr. Lawrence C. Wroth, librarian, John Carter Brown Library, Providence, R. I.

"The Student of Life," Dr. Robert E. Spiller, professor of English, Swarthmore College.
"Adventure in Agriculture," Dr. Carl R. Woodward, secretary of Rutgers University.
"Dr. Franklin as the English Saw Him," Dr. Conyers Read, professor of English history, University of Pennsylvania.
"Dr. Franklin and Science," Dr. R. A. Millikan, physicist, California Institute of Technology.
Closing address, Dr. Carl Van Doren.

THE EIGHTH AMERICAN SCIENTIFIC CONGRESS

THE eighth American Scientific Congress will be held in Washington, D. C., from May 10 to 18, 1940, under the auspices of the government of the United States of America.

Pursuant to a special act of the Congress of the United States, invitations on behalf of the President have been extended to the governments of the American Republics who are members of the Pan American Union to participate in the forthcoming meeting. Scientific institutions and organizations are also cordially invited to send representatives.

On April 14, 1940, the Pan American Union will celebrate the fiftieth anniversary of its founding. Although the eighth American Scientific Congress will convene a few weeks subsequent to the anniversary date, the congress will be one of the important phases of that celebration. It is hoped that the presence in Washington of many distinguished investigators from all the American republics as participants in this congress will serve as one of the many tributes to the Pan American Union on the occasion of celebrating the completion of a half century of invaluable service in the fostering of good-will and better understanding among the republics of the Western Hemisphere.

This series of inter-American meetings, serving as a medium for the exchange of scientific information of particular interest and importance to the governments and peoples of the Americas, has enjoyed a long and distinguished history, dating from the first Latin American Scientific Congress held at Buenos Aires in April, 1898.

The Honorable Cordell Hull, Secretary of State of the United States, has requested the following government officials and scientific men to serve upon an organizing committee, which is collaborating with the Department of State in formulating definite plans for the congress:

The Honorable Sumner Welles, Under Secretary of State, *chairman.*
Dr. Warren Kelchner, acting chief, Division of International Conferences, Department of State, *vice-chairman.*
Dr. Alexander Wetmore, assistant secretary of the Smithsonian Institution, *secretary.*
Dr. C. G. Abbot, secretary of the Smithsonian Institution.
Dr. Isaiah Bowman, president, The Johns Hopkins University.
Dr. Vannevar Bush, president, Carnegie Institution of Washington.
Dr. Ben M. Cherrington, chief, Division of Cultural Relations, Department of State.
Laurence Duggan, chief, Division of the American Republics, Department of State.
Dr. Ross G. Harrison, chairman, National Research Council.
Dr. Waldo G. Leland, secretary, American Council of Learned Societies.
Archibald MacLeish, librarian of Congress.
Dr. Thomas Parran, Jr., surgeon general, United States Public Health Service.
Dr. Stuart A. Rice, chairman of the Central Statistical Board.
Dr. Leo S. Rowe, director general, Pan American Union.
Dr. James Brown Scott, trustee and secretary, Carnegie Endowment for International Peace.

Dr. Wetmore has been designated also as secretary general of the congress.

The congress will be divided into the following sections, each to be in charge of a chairman, assisted by a vice-chairman, secretary and section committee:

I. Anthropological Sciences.
II. Biological Sciences.
III. Geological Sciences.
IV. Agriculture and Conservation.
V. Public Health and Medicine.
VI. Physical and Chemical Sciences.
VII. Statistics.
VIII. History and Geography.
IX. International Law, Public Law and Jurisprudence.
X. Economics and Sociology.
XI. Education.

The chairman of the respective sections will be selected at an early date, after which the detailed agenda of each section will be announced. The official languages of the congress will be English, Spanish, Portuguese and French.

The Department of State and the organizing committee are preparing an entertainment program which will include visits to places of scientific and general interest in Washington and its environs.

AWARDS OF THE AMERICAN SOCIETY OF MECHANICAL ENGINEERS

THE American Society of Mechanical Engineers will hold its fifty-ninth annual meeting at the Hotel Bellevue-Stratford, Philadelphia, from December 4 to 8. A list of the 1939 honors and awards to be presented on December 6 to members and junior members of the society has been made public. They are:

The Melville Medal, presented annually for an original paper or thesis of exceptional merit presented before the society, to L. M. Goldsmith.

The medal of the American Society of Mechanical Engineers to James E. Gleason, president, the Gleason Works, Rochester, N. Y., "for service to the cause of safer and better transportation."

The Holley Medal to Dr. Carl Edvard Johannson, Eskilstuna, Sweden, "in recognition of his pioneer work in the development of basic measuring gages," which are used throughout the world by machine and engine manufacturers.

The Worcester Reed Warner Medal to Dr. Rupen Eksergian, Edw. G. Budd Mfg. Co., Philadelphia, Pa., "for influential engineering papers of permanent value published in the *Transactions* of the American Society of Mechanical Engineers.

The Pi Tau Sigma Medal to John I. Yellott, assistant professor at Stevens Institute of Technology, Hoboken, N. J., with the citation, "outstanding young mechanical engineer of 1939."

The Charles T. Main Award of $150 to James R. Bright, Swampscott, Mass., graduate of Lehigh University, and now a student engineer, General Electric Co., for his paper, "The Economics of Investment in New Manufacturing Equipment—With Concrete Cases."

The Undergraduate Student Award of $25 to David T. James, Modeltown, N. Y., graduate of Michigan State College and now cadet engineer, E. I. du Pont de Nemours and Co., Niagara Falls, N. Y., for his paper, "Bells—Concerning Their Tones."

AWARD OF THE WILLARD GIBBS MEDAL

DR. VLADIMIR N. IPATIEFF, who came to this country from Russia in 1931, has been awarded the Willard Gibbs Medal of the Chicago Section of the American Chemical Society for 1940. The citation referred to him as "occupying a place of the first order in modern chemistry."

Dr. Ipatieff is internationally known for chemical discoveries basic to petroleum refining and to the organic synthesis of artificial rubber and of many other industrial products. He is now professor emeritus of Northwestern University, where he directs research in catalytic high pressure syntheses, and director of chemical research in the Riverside, Ill., laboratories of the Universal Oil Products Company.

In announcing the award Dr. Cary R. Wagner, chairman of the Chicago Section and of the Medal Jury, gave the following account of Dr. Ipatieff's work:

Dr. Ipatieff's chemical achievements in the field of catalysis and high pressure synthesis date from 1897. During the World War, Dr. Ipatieff was in charge of all chemical work for the Russian Government, with the rank of general and after the revolution he became president of the Central Chemical Bureau and founder of the High Pressure Research Institute. For this work he received the Lenin prize.

Dr. Ipatieff's work is of the same high order as that of the other European Willard Gibbs Medalists, who have included Mme. Marie Curie, of France; Svante Arrhenius, of Sweden; Sir James Irvine, of Scotland, and Dr. Richard Willstaetter, of Munich.

His discoveries of catalytic dehydration, hydrogenation, dehydrogenation and polymerization have placed his work in a commanding position for the past four decades and are the basis for many industrial processes, particularly in the refining of petroleum and synthesis of hydrocarbons.

Between 1900 and 1933 his researches were published almost entirely in Russian and German publications. In the last eight years he has been able to start research afresh in a new land with results that have been very far-reaching. His newer researches have extended the chemistry of the hydrocarbons greatly. He has developed a polymerization process to make high octane gasoline.

In 1897 in the laboratory of Professor Adolf von Bayer, Ipatieff synthesized for the first time isoprene, building stone of the complex rubber molecule, thus making possible the later synthesis of artificial rubber. In 1901 he began research in catalytic reactions under high pressures while working in the laboratory of the Academy of Artillery in St. Petersburg. He noticed, in 1901, the effect of catalysts on the decomposition of compounds, especially alcohols under high pressures and elevated temperatures. Simultaneously he discovered a method of making olefins from alcohols by passing the latter over alumina, a catalyst. Olefins have become the "raw" material for many organic compounds. The discovery was of very great industrial importance.

Dr. Ipatieff in 1903 and 1904 experimented extensively with the use of high pressures in the hydrogenation of various organic compounds, and these experiments were the forerunner of the Bergius process by which motor fuel is produced from coal. In 1905 he first introduced high pressures in polymerization of ethylene and other olefins. Continuing studies of polymerization in the presence of various catalytic agents, he found a catalyst which allows the transformation of a portion of the olefin-containing gases from cracking operations into an excellent high octane gasoline.

The work of Dr. Ipatieff in catalysis during the last thirty-five years enriched science by several major discoveries. He discovered several new catalytic agents, such as iron, zinc, manganese and their dioxides, important in the manufacture of dyes and fuels. He also first indicated the action of promoters, substances which aid catalysts, on the accelerated activity of catalytic agents. He has developed the chemistry of the paraffin hydrocarbons, compounds from which motor fuels and lubricants are made.

RECENT DEATHS

DR. WILFRED THOMAS DAWSON, professor of pharmacology in the School of Medicine of the University of Texas, died on September 19. He was forty-four years of age and had been connected with the School of Medicine since 1925. He was appointed to the professorship of pharmacology in 1927.

DR. NELSON FITHIAN DAVIS, professor of biology and head of the department of biology of Bucknell University from 1907 to 1937, died on November 11 at the age of sixty-seven years.

DR. WILLIAM REGINALD MORSE, co-founder and dean for fifteen years of West China Union University Medical School at Chengtu, died in Boston on November 11 at the age of sixty-three years. For the last two years he had been working at Harvard University. Dr. Morse spent thirty years in West China, where he had been engaged in medical work and anthropological research.

DR. ROBERT MARSHALL, chief of the Division of Recreation and Lands of the U. S. Forest Service, died suddenly on November 11. He was thirty-eight years old.

WENDELL PHILLIPS HOGE, laboratory assistant and computer at the Mount Wilson Observatory, died on November 14 at the age of seventy-two years.

SIR WILLIAM J. POPE, for thirty-one years professor of chemistry at the University of Cambridge, died on October 17 at the age of sixty-nine years.

VASILY ROBERTOVICH WILLIAMS, of Moscow, a specialist in agronomy, died on November 11 at the age of seventy-six years.

DR. ARTHUR JOHN HOPKINS, professor of chemistry emeritus of Amherst College, died on November 10 at the age of seventy-five years. A correspondent writes: "Professor Hopkins was born September 20, 1864, in Bridgewater, Mass., graduated from Amherst College in 1885, and took his Ph.D. under Morse at Johns Hopkins University in 1893. In 1894 he came back to Amherst, becoming full professor in 1907, in which position he served until his retirement in 1934. In 1895 he married Margaret Sutton Briscoe. He is survived by his wife and his daughter, Mrs. Cornelia Allen. Although he is credited with a number of contributions to the field of inorganic and analytic chemistry, in which he was always interested, Professor Hopkins was best known for his life-long study of the early history of the science. His 'color theory' of early alchemy has done much to clarify the obscurity of the Greek alchemical writings. In a series of articles in *Isis* and in his book, "Alchemy, the Child of Greek Philosophy," published by the Columbia University Press in 1934, he showed that the Alexandrian alchemists, believing that color was the chief property of metals, were trying to put into practice the philosophical ideas of Plato and the Gnostics. They were trying to push the baser metals along the road to 'improvement,' through a series of color changes which can be recognized as actual chemical processes, carried out with ingenious if primitive chemical apparatus."

SCIENTIFIC NOTES AND NEWS

PROFESSOR P. DEBYE, director of the Kaiser Wilhelm Institute of Physics at Berlin-Dahlem, will be the George F. Baker non-resident lecturer in chemistry at Cornell University for four months, beginning with the second term of the academic year. He will discuss the determination of molecular structure by the method of interferences. The German Government has granted Dr. Debye leave of absence to accept the lectureship.

PROFESSOR THEODOR VON KÁRMÁN, director of the Daniel Guggenheim Aeronautical Laboratory of the California Institute of Technology, will give the fifteenth Josiah Willard Gibbs Lecture of the American Mathematical Society. The title of the lecture is "The Engineer Grappling with Non-linear Problems." It will be given at the annual meeting of the society, which will be held at Columbus on December 28, 29 and 30 in conjunction with the American Association for the Advancement of Science.

THOMAS H. CHILTON, director of the Technical Division of the engineering department of the E. I. du Pont de Nemours and Company, Wilmington, Del., was presented with the Charles Frederick Chandler Medal at a ceremony held at Columbia University on November 7. The presentation was made by Dean Joseph Barker, of the Columbia School of Engineering, which is celebrating the seventy-fifth anniversary of its founding as the first School of Mines in the United States by Dr. Chandler and his associates in 1864. Following the presentation Mr. Chilton gave the annual Chandler lecture entitled "Engineering in the Service of Chemistry." Mr. Chilton is the seventeenth Chandler medalist. The medal was awarded to him for "the discovery and formulation of principles underlying the unit operations of chemical engineering, and in the application of these principles to process development, equipment design and chemical plant construction and operation."

THE medal of the Society of Chemical Industry was presented on November 10 to Dr. Robert E. Wilson, president of the Pan American Petroleum and Transport Company, at a meeting at New York City of the Chemists Club, sponsored by the American Section of the Society of Chemical Industry and the New York Section of the American Chemical Society and the New York Section of the American Institute of Chemical Engineers.

DR. ARTHUR H. COMPTON, Charles H. Swift distinguished service professor at the University of Chicago, on November 8 was the guest of honor at a

dinner at St. Louis sponsored by several scientific and religious groups. Dean Alexander S. Langsdorf, of the Washington University School of Engineering and Architecture, presided. Following the dinner, Dr. Compton spoke at the Centenary Church.

DR. HUGH S. TAYLOR, David B. Jones professor of chemistry and chairman of the department of chemistry of Princeton University, was the guest of his associates and former graduate students at a dinner held on the evening of October 21, given in honor of "twenty-five years of distinguished service to chemistry at Princeton." Following the dinner he was presented in the name of former graduate students with a silver smoking set by Dr. W. N. Henderson, of the Allied Chemical and Dye Corporation, New York. Dr. Taylor, in his response, surveyed the development of chemistry at Princeton in the last quarter century.

A MEETING was held at the St. Louis Medical Society on October 24 in honor of Dr. William Washington Graves, professor of neuropsychiatry at the St. Louis University School of Medicine. At this meeting Dr. Graves was awarded the certificate of merit and a gold medal for scientific accomplishment. The certificate reads: "In consideration of the usefulness of his classification of scapulae and other inherited characters, and of his discovery of 'The Age-Incidence Principle of Investigation,' both of which resulted in new approaches to the qualitative evaluation of inherited variations in relation to the inherited qualities of human constitution, expressed in inherited predisposition to health or disease, and in inherited capacity for education, for adaptability and for longevity." On only two occasions before this the St. Louis Medical Society has awarded this certificate of merit for scientific accomplishment. The first was given to Dr. Evarts A. Graham and his associates in 1927 for their work in cholecystography; the second to Dr. Edward A. Doisy in 1935, for his achievements in hormone chemistry and physiology.

DR. JOSEPH B. DE LEE, professor emeritus of obstetrics and gynecology of the School of Medicine of the Division of Biological Sciences, University of Chicago, observed his seventieth birthday on October 29 at a party planned to benefit the Chicago Maternity Center, which he founded. He was presented with cuff links forged from a pair of forceps that he used in his early days of practice.

THE Soviet Government has awarded the Order of Lenin to Dr. Vladimir Leontievitch Komarov, president of the Academy of Sciences of the U.S.S.R., in honor of his seventieth birthday and "in appreciation of his great services to science."

DR. SETON PRINGLE, surgeon to the Hospital of the Royal City of Dublin and lately president of the Royal College of Surgeons of Ireland, has been elected president of the Irish Royal Academy of Medicine.

AT the autumn meeting of the Virginia Chapter of Sigma Xi, the following officers were elected: *President,* Gordon T. Whyburn; *Vice-president,* James E. Kindred; *Secretary,* Joseph K. Roberts, and *Treasurer,* Lawrence R. Quarles. Dr. Jesse W. Beams, professor of physics at the University of Virginia, will be one of the lecturers this year. His subject will be "High Speed Centrifuging."

DR. DARIEL E. HOWELL has been appointed assistant professor of entomology at Oklahoma Agricultural and Mechanical College to take the place of Dr. L. E. Rozeboom, who resigned to become a member of the department of medical entomology at the Johns Hopkins University. Dr. Howell will have charge of investigations dealing with insect and tick transmission of bovine anaplasmosis, and will teach courses in medical entomology and pest control.

DR. JOHN C. HAFF, of the petrographic laboratory of the Bureau of Reclamation in Denver, has been appointed assistant professor of geology at the Colorado School of Mines.

AT the meeting of the Board of Scientific Directors of the Rockefeller Institute for Medical Research, New York, held on October 28, Professor Warfield T. Longcope, of the Johns Hopkins Hospital, was elected president of the board to succeed Dr. Charles R. Stockard, who died on April 7 of the present year. Professor Ross G. Harrison, of the Osborn Zoological Laboratory, Yale University, was elected a member of the Board of Scientific Directors of the Institute.

PROFESSOR EDMUND W. SINNOTT, professor of botany at Barnard College, Columbia University, has been elected a member of the Board of Trustees of *Biological Abstracts.* Members of the editorial board have been elected as follows: Dr. Robert S. Breed, Agricultural Experiment Station, Geneva, N. Y., "Dairy Bacteriology"; Professor Adriance S. Foster, University of California, "Morphology and Anatomy of Vascular Plants"; Dr. A. G. Karlson, University of Minnesota, associate editor, "Infectious and Other Diseases of Lower Animals"; Dr. Josef N. Knull, the Ohio State University, "Coleoptera"; Professor Gilbert M. Smith, Stanford University, "Algae"; and Robert G. Stone, Blue Hill Observatory of Harvard University, "Biometeorology and Bioclimatology."

DR. LOUIS B. BISHOP, of Pasadena, Calif., has been given an honorary appointment on the staff of Field Museum of Natural History as research associate in the division of birds. Dr. Bishop was responsible for the assemblage of one of the largest and most impor-

tant collections of North American birds. It is known as "the Bishop collection" and was recently acquired for addition to the department of zoology. More than 50,000 specimens, representing nearly every known form of bird found in North America, are included.

THE Committee on Scientific Research of the American Medical Association has made a grant to Robert R. Sealock, of the Univeristy of Rochester, to continue his investigations on the relationship of ascorbic acid to the metabolism of the melanin pigment precursors.

DR. HUGH S. CUMMING, formerly surgeon-general of the U. S. Public Health Service, sailed for Europe on November 11. He will attend a meeting of the Health Committee of the League of Nations.

DR. OSCAR RIDDLE, of the Research Staff of Carnegie Institution Station for Experimental Evolution at Cold Spring Harbor, N. Y., gave an address before the Massachusetts State Chapter of Sigma Xi at Amherst on the evening of November 15 on "Our Uncontrollable Governor—the Pituitary Gland."

DR. ROBERT MEYER, formerly director of the Pathological Institute (Gynecological Clinic) and honorary professor of the Friedrich-Wilhelms University, Berlin, will give on December 6 and 7 the Charles Sumner Bacon lectures of the University of Illinois for 1939–1940 in the Medical and Dental College Laboratories Building at Chicago. The titles of the lectures are: "The Basis of the Histological Diagnosis of Carcinoma" and "Diagnosis of Early Carcinoma of the Cervix."

PROFESSOR K. K. LANDES, chairman of the department of geology of the University of Kansas, recently presented a series of three exchange lectures at the University of Cincinnati. The titles of the lectures were: "Pegmatites," "Igneous Rocks of the Mississippi Valley" and "Volcanic Ash in the Western United States." A fourth lecture, on a geologic exploring trip in Alaska, was given before the Cincinnati chapter of Sigma Xi. Professor N. M. Fenneman, of Cincinnati, had previously given a series of lectures on physiographic topics at the University of Kansas.

AT the twenty-fourth annual meeting of the Institute of Medicine of Chicago at the Congress Hotel on December 5, Dr. Arthur H. Curtis, professor and chairman of the department of obstetrics and gynecology at Northwestern University Medical School, will deliver the presidential address on "Some New Features of Gynecological Anatomy and Related Clinical Problems."

THE two hundred and thirtieth regular meeting of the American Physical Society will be held in Chicago on Friday and Saturday, December 1 and 2.

THE University of North Carolina on Monday, December 4, will celebrate the opening of the new Medical Laboratories Building as part of its general Sesqui-Centennial Celebration. The exercises will consist in the morning of an address by Professor E. K. Marshall, Jr., of the Johns Hopkins Medical School, on "Medical Research: the Story of Sulfanilamide." In the afternoon Dr. David Riesman, professor emeritus of clinical medicine and professor of the history of medicine, the Medical School of the University of Pennsylvania, will make an address entitled "The Making of a Clinician," and Dr. G. Canby Robinson, lecturer in medicine and director of the Medical Clinic of the Johns Hopkins University Medical School, will speak on "The Application of Medical Science to the Individual." An informal tea in conjunction with the inspection of the medical laboratories and the medical dormitory will be held in the Charles E. Kistler Memorial Library of the Medical School. In the evening Dr. Frank G. Boudreau, executive director of the Milbank Memorial Foundation, will speak at a dinner gathering on "New Health Frontiers." Greetings will be brought to the university and to the Medical School by various alumni and friends.

IT is announced that requests to the National Research Council Committee for Research in Endocrinology for aid during the fiscal period from September 1, 1940, to June 30, 1941, will be received until February 29. Application blanks may be obtained by addressing the Division of Medical Sciences, National Research Council, 2101 Constitution Avenue, Washington, D. C. In addition to a statement of the problem and research plan or program, the committee desires information regarding the proposed method of attack, the institutional support of the investigation and the uses to be made of the sum requested. No part of any grant may be used by the recipient institution for administrative expenses. Applications for aid of endocrine research on problems of sex in the narrower sense can not be given favorable consideration, but the committee will consider the support of studies on the effects of sex hormones on non-sexual functions—*e.g.*, on metabolism.

DR. STEPHEN DUGGAN, director of the Institute of International Education, has been forced to cancel for the duration of the war all student exchanges between the United States and Europe. The institute had expected to send four hundred American students abroad on fellowships. Three hundred of these have been cancelled, since they were for European universities, but the remainder, involving Latin America, Canada and the Far East, have not been affected.

OVER two hundred courses in clinical medicine for practicing physicians are being given by the Columbia University School of Medicine at metropolitan hospitals affiliated with the school during the academic

year 1939–40. These are designed for continuation training and advanced experience in the clinical fields of medicine, and are divided into separate sections for general practitioners and for specialists. The hospitals affiliated with the School of Medicine are as follows: Bellevue; Hospital for Joint Diseases; Institute of Ophthalmology; Lenox Hill; Montefiore; Mount Sinai; Margaret Hague Maternity Hospital; Neurological Institute; New York Post-Graduate Medical School; New York State Psychiatric Institute and Hospital; Presbyterian Hospital; St. Luke's; Welfare Hospital for Chronic Diseases, and Woman's Hospital.

DISCUSSION

THE FOUNDING OF A DEPARTMENT OF FISHES IN THE MUSEO POEY OF THE UNIVERSITY OF HAVANA

FELIPE POEY (1799–1891) was Cuba's greatest naturalist. He was made professor of natural history in the University of Havana in 1830, and in 1839 he was appointed director of the museum in the university. He published rather widely on Cuban natural history, but he is best known by reason of his excellent work on Cuban fishes. His first ichthyological contribution appeared in 1851 and his last in 1883. In the space of these thirty-two years his publications on fishes number nineteen, and of these five were stout volumes. These volumes were issued in fascicules or parts as they were finished and were then gathered into volumes with inclusive titles. If these individual parts could be counted, they would probably treble the number of Poey's separate contributions. Only by thumbing through his works could the total number of fishes described by him be ascertained. But it is said that he described *de novo* more than 230 species.

Since Poey's day the study of Cuban fishes has been carried on intermittently by various investigators from various countries. These studies have consisted mainly of descriptions of one or a few species or at best of small collections. Now, however, plans are on foot for extensive and far-reaching studies, which will recall the days of Felipe Poey. His work is to be taken up and continued by a man who has already written extensively on Cuban fishes and who bids fair to be a worthy successor of Poey.

The Museum of Zoology (Museo Poey) of the University of Havana has recently established a department of fishes for the study and preservation of the fishes of the West Indian fauna, and particularly those of the Cuban waters.

The organization and establishment of this department are due to the initiative and activities of Dr. Luis Howell Rivero, professor in the faculty of science. Dr. Rivero was for two years (1934–1936) a fellow of the Guggenheim Foundation doing research work on West Indian fishes at the Museum of Comparative Zoology at Harvard College and at the Museum of Zoology of the University of Michigan. He has had the cooperation of his colleague, Dr. Carlos G. Aguayo (also a former Guggenheim fellow), and of Dr. José M. Cadenas, rector of the University of Havana, who has provided the necessary appropriation for the maintenance of the department.

The first great collections for the establishment of this department are the following accessions:

Fishes obtained by the "Tomas Barrera Expedition" in 1914, under the direction of Dr. Carlos de la Torre, from the University of Havana and of Dr. Paul Bartsch, of the U. S. National Museum.

Fishes obtained by Dr. Rivero in Jamaica in the spring of 1937, during a survey of the fishes of Jamaica done under the auspices of the Museum of Comparative Zoology at Cambridge, Mass., the Department of Science and Agriculture of Jamaica and the University of Havana.

Fishes obtained by the "Harvard-Havana Expedition" in the spring of 1938, and by the second expedition, March to May, 1939, under the auspices of Harvard University and the University of Havana, undertaken on board the research vessel *Atlantis*.

Besides, there are several small local collections made by Dr. Rivero, Dr. Aguayo and others, as well as many donations which have been made to the museum.

At the present moment and taking into consideration its very early stage, the department of fishes has over 50 per cent. of the species of the known Cuban fauna represented in its collections, and now that this department is prepared adequately to care for specimens, it is confidently expected that much valuable material will be presented to the Museo.

In this new department of the university, courses of lectures and laboratory work will be given by Dr. Rivero, its founder. In addition opportunities will be afforded graduate students to do research work on fishes under Dr. Rivero's immediate direction. Thus the Museo Poey of the University of Havana may be expected to become the center of work on the West Indian ichthyological fauna.

CORRESPONDENT

A NOTEWORTHY AURORA

ON the night of August 1, 1937, there occurred an extremely spectacular display of the aurora borealis, visible, no doubt, in many of our northern states and in Canada. I watched it from the Musselshell Valley of central Montana, where I write this, and was s

impressed by its many unusual aspects that I felt a brief account of it might be of interest for permanent record. Before I could find opportunity to work up my notes for this purpose, a very fine and detailed description of what was doubtless the same phenomenon was published in SCIENCE by Ernest H. Cherrington, Jr., and my own contribution was allowed to lapse.

The aurora of the night of August 11 of this year, also witnessed by me from this spot, ranked with the foregoing as one of the three most magnificent I have had the good fortune to witness,[1] but in some particulars it was altogether unique. When first observed at about 9:20 P.M. it comprised a single sweeping auroral arch in the northern heavens, but one reared so high that it included almost half the horizon between its termini, while its vertex nearly attained the zenith. At this time it appeared from my window as a simple broad band of strong whitish light, not without a serene majesty of its own. This was little prophetic of the glory to come, yet I roused a friend, Harold M. Hill, who had never witnessed an aurora, and it was consequently our good fortune to be in the open with an unimpeded view of the entire firmament when the climax came.

The first evidence of breaking was a narrow beam or ray which appeared to the northwest just under the span. The arch then rapidly broke up, with strong cloud-like patches of light appearing to east and west, while the portion between evolved into an array of luminous shafts or streamers so grouped as to seem to radiate from a roughly stellate centrum just south of the zenith in the general neighborhood of Vega. The best of the display occurred from about 9:45 to 10:00 o'clock, when the fast-changing beams and rays covered more than half the heavens, and rapidly shifting lesser flickerings were flashing all over and through the whole. At its peak nearly three fourths of the sky was illuminated, although the radiating streamers to the south of the centrum were very short, in contrast to those extending far down the northern sky and the still longer ones to east and west. Also on the south there was more of a tendency for the beams to give way to scattered, irregular spots and clouds of light than in other parts of the heavens. By this time considerable color had developed, mostly reddish, orange and pinkish brown tones which again were much more in evidence to the extreme east and west than elsewhere. After 10:00 o'clock the illumination lost its active motion and most of its color, retreating more and more into the northern sky, where it finally resolved itself into a simple diffused arch of the more usual type. This endured until we retired, and was still in evidence when I arose to look, around 1:00 A.M. and again just before dawn, though meanwhile considerable cloudiness had developed to obscure its details. I was unable to note any recurrence of the more lively pyrotechnics. As long as the first arch persisted, the northern sky remained quite dark under it, but at no time did I observe the intense contrasting *blackness* there which was so conspicuous an accompaniment of the arch of August, 1937.

It occurred to me at the time that the centering of the major display so definitely *south* of the zenith might well entail a visibility in much lower latitudes than is ordinarily the case for such phenomena. This has since received confirmation through newspaper reports, from one of which[2] it transpires that on this night the aurora was seen at least as far south as Summit Lookout in Cajon Pass and Lake Arrowhead in the San Bernardino Mountains of southern California, where some observers are reported to have interpreted it as the glow of a distant forest fire.

S. STILLMAN BERRY

WINNECOOK, MONTANA

OZONE IN THE '38 HURRICANE

DURING the hurricane on September 21, 1938, the smell of ozone was strong during the latter part of the storm. The peak of the storm was shortly after 6 P.M. (D.S.T.); the lowest barometer 28.41 (corrected) at Amherst, Mass., being at 6:05, and the highest wind velocity, 80 miles, at 6:17. During the heavy rain, about 6 to 6:30, the ozone was strong, and later, when the rain stopped, the ozone was so strong I was uncomfortable. At this time my watch said 7 o'clock. No odor of ozone was noticed in the first part of the storm nor was any noticeable in the house. My colleague in chemistry, in the Massachusetts State College, Dr. Walter S. Ritchie, independently reports similar observations.

CHARLES A. PETERS

AMHERST, MASS.

THE INTERNATIONAL UNION OF CHEMISTRY

COMMUNICATIONS have been received from individuals and organizations of many lands requesting advice as to whether or not they should endeavor to continue the work of the Union and its various commissions during the present chaotic condition of the world, or suspend operations until the return of peace and the general resumption of friendly international relations.

The answer to this question in the judgment of the writer should be unequivocally that the work is to go on, if possible still more actively than heretofore, not only in its local national field, but particularly in its international aspects. The Union, as its name signifies,

[1] For the third of these see SCIENCE, 44: 496, 568, 678, October and November, 1916.

[2] *Redlands* (Calif.) *Daily Facts,* August 12, 1939.

is an organization of scientists banded together for the good, not of any one country, but of all. Its aims are the welfare and happiness of all mankind, through the advancement of civilization by the triumphs of chemistry. No science offers greater opportunities for service and beneficent achievement. When the Union and its affiliated congress meet, as at Rome last year, where about 3,000 attended, representing some 30 nations, national boundaries and misunderstandings are forgotten, and mutual appreciation, esteem and good fellowship prevail. This spirit of friendship and regard, carried back home by all the delegates, is often like a breath of fresh air in dispersing the fogs of a murky local atmosphere of misapprehension and suspicion. Nor does it cease upon their arrival in the homeland, but in many cases is continued through correspondence. Individually the bonds of friendship so established may seem relatively unimportant, but collectively their Lilliputian character becomes a force not to be ignored.

The usefulness of the International Union of Chemistry and of its various commissions and committees will be determined primarily by the wholeheartedness with which the associated nations cooperate, and the fact that certain nations are now at war is no reason why the other nations concerned should not continue to cooperate and, to the best of their ability, take advantage of those opportunities for important useful service which the International Union offers, so that when the world finally returns to normal we shall be that much further along on the road to our goal. Even in the warring nations, it is to be hoped that they will still "carry on," as conditions permit, for their own ultimate benefit and that of the rest of the world. Their chemical societies are still active. Why should their international chemical problems be either dropped or forgotten?

To suspend activities now might give the impression of a malingering and pessimistic attitude, totally at variance with the inspiring vision and courage of chemists the world over.

MARSTON TAYLOR BOGERT,
President, International Union of Chemistry
COLUMBIA UNIVERSITY,
NEW YORK

SCIENTIFIC BOOKS

RECENT BOOKS IN GEOLOGY

Geology: Principles and Processes. By W. H. EMMONS, G. H. THIEL, C. R. STAUFFER and I. S. ALLISON. 2nd edition. 451 pp. 468 figs. New York: McGraw-Hill Book Company. 1939. $3.50.

Elements of Geology (with Reference to North America). By WILLIAM J. MILLER, professor of geology, University of California at Los Angeles. 2nd edition. viii + 524 pp. 367 figs. New York: D. Van Nostrand Company. 1939. $3.50.

Textbook of Geology, Part I—Physical Geology. By CHESTER R. LONGWELL, ADOLPH KNOPF and RICHARD F. FLINT. 2nd edition. ix + 543 pp. 340 figs. New York: John Wiley and Sons. 1939. $3.75.

THE second edition of the book by Emmons, Thiel, Stauffer and Allison, members of the department of geology in the University of Minnesota, originally published under the short title "Geology," has been considerably revised and completely reset. It is intended for use in a one-semester introductory course for college students, dealing with the physical phases of the science. The chapter on the atmosphere and the work of the wind has been enlarged and includes a brief consideration of certain meteorological principles as well as the discussion of weathering. The treatment of varved glacial lake sediments and their importance in glacial and post-glacial chronology has been expanded. The chapter on diastrophism has been enlarged to include structure of rocks. A new chapter on sediments and sedimentation has been added. The chapter on earth history is omitted. The volume is well organized, and its subject-matter is presented in an interesting manner. It contains an unusually large number of excellent photographs, sketches and maps. The numerous block diagrams are a valuable feature. The layman as well as the student will benefit from reading it.

First published in 1931, Professor Miller's textbook is one of the few designed to serve a one-semester course in general geology, covering both the physical and historical phases of the science. The principal changes made in this new edition are outlined by the author in his preface. Distinct and important improvements are the enlarged, more attractive format, superior quality paper and especially the greatly improved reproduction of the photographs. More photographs and block diagrams are used, and these have been brought up to date. Several chapters have been rewritten to coincide with modern data and concepts. A unique feature is the discussion of the instability of the earth's crust immediately after the introduction before the materials of the earth are considered. The chapter is understandable even at this early stage in the development of the subject and serves to stimulate interest at the beginning of the course. The text may seem to be rather long for a one-semester course, but this characteristic is shared

y most other texts intended to serve such a purpose ithout becoming too "popular" in character. A elatively large number of technical terms and strati-raphic names are used.

The well-known text-book by Longwell, Knopf and lint has likewise been thoroughly revised to include uch new material from laboratory and field studies f recent years. Although the general plan of the ook remains unchanged, two new chapters have been dded. One of these considers such movements of rficial material as those resulting from creep and ndsliding, all of which are included in the suggested rm "mass-wasting." The other is devoted to the culpturing of the lands and follows the development f the principles of weathering, mass-wasting and ream erosion. This gives opportunity for the con-ideration of the erosion cycle under diverse climatic onditions and leaves room in the preceding chapter or a brief but effective treatment of the problems of il erosion and destructive floods. In contrast to rtain other comparable text-books, technical terms ave been avoided as much as possible, and some of he newly added references are to popular or semi-opular books. Many of the new illustrations are lso in keeping with this highly commendable tendency o put vitality into a subject which ought to have a ide appeal to everybody.

hysiography of Eastern United States. By NEVIN M. FENNEMAN. 691 pp., maps, photographs and diagrams, index. New York: McGraw-Hill Book Company. 1938. $6.00.

THIS excellent reference work summarizing the hysiographic features of Eastern United States is a mpanion volume to the author's "Physiography of estern United States" and follows the same general lan. The portion of the United States east of the reat Plains is divided into provinces and sections milar, but not precisely equivalent, to those shown n the map of the "Physical Divisions of the United tates" which accompanies the earlier volume. The oundaries of each province and section are traced in etail, and the reasons for the choice of boundaries are iscussed. Each province and section is systemati-lly treated by means of a brief résumé of the litholo-gy and structure, a general description of the topog-aphy, an account of the origin of the topography and nally the history of its development. The space ven each province corresponds roughly to its size nd importance. The book is well indexed and so ystematically divided that the description of any articular region can easily be found.

In discussing the origin and history of the topog-aphy the views of many workers are carefully con-dered and appraised, the conservative view being nally accepted in most instances of conflict. Fre-quent references to important physiographic problems and their proper interpretation enhance the interest in the subject-matter and the value of the book for the student.

The enormous amount of descriptive material packed into the volume places a severe strain upon the memory of the reader, and unfortunately many of the illustrations do not aid him in understanding the text as much as might be desired. But the very difficult task of assembling such a vast amount of uncoordinated data and reconciling the conflicting opinions of so many workers has been accomplished with remarkable success. The book is a valuable reference work for any natural scientist who may have occasion to be interested in the land surface of the eastern states and its genesis.

A Textbook of Geomorphology. By PHILIP G. WORCESTER. 565 pp. 375 illustrations. New York: D. Van Nostrand Company. 1939. $4.00.

GEOMORPHOLOGY is the interpretative description of the relief features of the earth. So runs the definition preferred by the author of this handsome volume, who for many years has been professor of geology in the University of Colorado. The term is therefore practically synonymous with physiography, the designation more commonly used in America for the science of land forms. Probably there is an advantage in using a term that by derivation implies study or interpretation rather than one that implies merely description.

The book has been planned for an introductory course in the geological sciences, and its table of contents differs only slightly from that ordinarily found in an elementary text for a course in dynamic geology. From it one may learn to distinguish orthoclase from plagioclase, as well as eskers from drumlins. More space is given to the causes of vulcanism than to the topographic forms resulting from the deposition of wind-blown sand. Professor Worcester approaches the subject from the point of view of the geologist rather than from that of the geographer.

There is still need for a treatise on geomorphology of a more advanced nature, designed for use by those who are already fairly well acquainted with the principles of dynamic geology and who need a thorough-going critique of the resultant land forms and their interpretation. Neither the volume now in hand nor the recently published book by Dr. A. K. Lobeck is adequate for the professional geomorphologist; both are intended for the beginning student and for the layman interested in the landscape. As a matter of fact, Professor Worcester appropriately stresses in his preface the cultural value of geomorphology and the responsibility of the teacher for the "thousands [who] may become interested in the subject and gain endur-

ing pleasure from continued studies of their physical environment, wherever they may be."

The wealth of illustrations deserves high commendation and contributes much to the value of the book, especially for the audience which Professor Worcester has in mind. Most, though not all of the photographs, are superb both from the point of view of photography and of reproduction. All are well chosen to illustrate the ideas ably presented in the text. The line drawings, including many block diagrams, are uniformly excellent and for the most part were originally prepared for this book by Julian W. Low. Many of the contour maps are reproduced in two colors, with the drainage features in blue. Both author and publisher are to be congratulated for producing so excellent a volume.

Geology and Engineering. By ROBERT F. LEGGET. xviii + 650 pp. 223 illustrations. New York: McGraw-Hill Book Company. 1939. $4.50.

DURING the last few years the application of the science of geology to the art of civil engineering has become a matter of prime importance. Whereas a generation ago the geologist was frequently called for a post-mortem examination of a leaking dam, collapsed bridge or faulty tunnel, he is to-day even more frequently requested to cooperate in the preliminary investigations of the materials on which or in which the engineer is to build his structure or do his work. The results in the saving of human lives and the reduction in the cost of engineering works are beyond estimate. Such cooperation has also contributed much valuable information to geological lore. Professor Legget's up-to-date treatise is a veritable milestone on the highway of human progress toward accurate synthesis of the diverse problems encountered in the arena of interplay between man and his environment.

As stated by Professor P. G. H. Boswell, of the Imperial College of Science and Technology, London, in his foreword, the several text-books of engineering geology previously available have been written by geologists. "Where engineering applications are discussed, in particular, they indicate what the geologist, from his rather different viewpoint, imagines that the engineer should know." In contrast, "this book is the work of an engineer with the additional training of a geologist" and has a background that would scarcely be possessed even by a geologist of wide experience as a consultant on engineering problems. It therefore fills a long-felt want and will be widely used in engineering schools and as a valuable tool of the professional geologist and civil engineer. Many a college teacher of geology will use to good advantage in his classroom the accounts of the practical application of geological principles with which Professor Legget has pointed his precepts.

The first four chapters introduce the engineering student to those phases of geological science with which he is most likely to be later concerned. The remaining sixteen chapters deal lucidly and succinctly with the application of geology in civil engineering. Tunnels, open cuts, road construction, bridge foundation, dam sites, silting up of reservoirs, wells and bore holes, landslides and soil mechanics, these and many other topics are ably handled. Especially commendable is the wealth of illuminating experiences drawn from engineering practice the world over and including such current projects as those of the T.V.A. and Boulder Dam. There are four appendices, which include a glossary of geological terms, an annotated list of the geological surveys of the English-speaking world and a list of geological societies and periodicals.

KIRTLEY F. MATHER

HARVARD UNIVERSITY

SOCIETIES AND MEETINGS

THE SEMI-CENTENNIAL CELEBRATION OF THE MEDICAL SCHOOL OF THE UNIVERSITY OF MINNESOTA

THE University of Minnesota celebrated from October 12 to 14 the fiftieth anniversary of the founding of its Medical School. The occasion was used as an opportunity to bring together a number of contributors to scientific medical progress in several fields, who presented accounts of recent advances with particular emphasis upon the unsolved problems which have been exposed and appear to be amenable to solution.

Progress in the application of physical chemistry to medicine was discussed by Professors Herbert M. Freundlich and Maurice B. Visscher, of the University of Minnesota, and John P. Peters, of Yale University. These investigators described living organisms as systems at steady states frequently, if not usually, at some distance from true equilibrium. The importance of the structure and properties of the colloidal systems in cells and of the metabolic energy-yielding reactions in maintaining these steady states was discussed.

Some recent investigations in metabolism were detailed by Professors Lee I. Smith and George O. Burr of the University of Minnesota, who discussed organic chemical problems in relation to Vitamin E, and the metabolism of the fatty acids, respectively, by Professor George H. Whipple, of the University of Rochester, who treated the problem of production, utilization, and significance of the blood proteins, and

Professor Charles H. Best, of the University of oronto, who summarized the present state of knowlge concerning the chemistry and physiology of eparin and concerning the clinical physiology of rombosis.

Chemical problems in immunity were discussed by rofessor Michael Heidelberger, of Columbia Univerty. Professor Robert G. Green, of the University Minnesota, described experimental modification of athogenic viruses in relation to the general problem the nature of viruses. Professors Perrin H. Long, Johns Hopkins University, and Henry F. Helmolz, of the Mayo Foundation of the University of innesota, discussed modern chemotherapy, the first ith particular reference to the sulfanilamide group, d the latter with reference to the specific problem urinary antisepsis.

Several approaches to the problems of the nervous ntrol of the organism were discussed. Professor vine McQuarrie, of the University of Minnesota, scribed experiments showing important chemical ctors in the production and control of convulsions man and in animals. Professor Herbert S. Gasser, the Rockefeller Institute for Medical Research, preted a general treatment of methods of analysis of rvous action which are being and can be extended in e investigation of the more intimate character of rvous conduction. Professor Detlev W. Bronk, of e University of Pennsylvania, described the results observations upon nervous control of such visceral rocesses as circulation and respiration. He dealt ith the problem of chemically sensitive receptors in flex regulation of body activities, showing the interpendence of chemical and physical mechanisms in ch control. Professor Walter B. Cannon considered e problem of chemical mediation of excitation at napses. He marshalled the existing evidence for emical mediation, particularly at cholinergic structres.

Public meetings were addressed by Dr. Thomas Parn, Jr., surgeon-general of the U. S. Public Health ervice, on "Medical Education, Research and the ublic Health"; by Professor Anton J. Carlson, of e University of Chicago, on "The Role of the Funmental Sciences in Medical Progress"; by President uy Stanton Ford, of the University of Minnesota, pon "The Place of Medicine in a University," and Governor Harold E. Stassen, on "Medicine in the ommonwealth." These speakers emphasized the eculiar importance of public support for medical ducation and research on a high plane in the interests the community itself, the necessity of research in e basic sciences for sound progress in the applied ience of medicine, and the importance of broader nd better cultural training for physicians themselves that they may play a larger and more enlightened role in the social and political changes which are going on at a rapidly accelerating pace. The relatively more important part that American science must play on the world scene in view of the catastrophies of war and authoritarianism in Europe and Asia was stressed as an additional reason for intensification and improvement in our scientific and cultural institutions. The scientific and general lectures presented at the semi-centennial celebration will shortly be published in two separate volumes by the University of Minnesota Press.

Since the State of Minnesota undertook responsibility for the guidance and support of medical education and research fifty years ago, the aims and needs for such service have changed greatly. Initially, the undergraduate training of physicians was viewed as its main task. About twenty-five years ago the university undertook the problems of graduate training and research in a serious way. At the present time the graduate teaching program is a larger undertaking than the undergraduate teaching. In comparison with some four hundred undergraduates in medicine there are over six hundred graduate students working toward advanced degrees in the several fundamental and clinical medical fields in this university. The larger share of those working in the latter fields are doing their work at the Mayo Foundation of the university at Rochester. With the extension in medical knowledge and the rise of specialization this work has acquired increased importance.

Relative to the wealth of the state, Minnesota has given large support to higher education, including medicine. Smaller support, which in the aggregate amounts to five millions of dollars, has come to the university for medical work from private sources, mainly from individual donors, but in smaller part from the large foundations.

The State of Minnesota has in the past accepted the principle that each generation should pay its debt to society for the scientific and cultural heritage which it enjoys by adding to the stock of knowledge which is the real groundwork of human wealth. In celebrating the completion of a half century of service to the community in medical education and research, the dominant note was the necessity for sound planning of a program for the future. President Ford expressed the conviction of many when he said, "If ever this nation, this state, this university had a responsibility for supporting science and research in the name of the common welfare, that responsibility is a measure now full and running over by reason of the tragic days just behind and just before the nations who fling from dying hands the torch to us to-day."

M. B. VISSCHER

THE MEDICAL SCHOOL,
UNIVERSITY OF MINNESOTA

SPECIAL ARTICLES

TOXIC EFFECTS OF DESOXYCORTICOSTERONE ESTERS IN DOGS[1]

IN the spring of 1939, a number of our patients with Addison's disease who were undergoing treatment with synthetic desoxycorticosterone acetate developed cardiac insufficiency. This varied considerably in degree but was severe in three instances. Furthermore, two patients complained of rapidly progressing weakness and died at home at a time when the blood pressure had been normal and no signs of adrenal insufficiency were recognized.

In view of the implication of these observations, it seemed imperative to study the effect of the protracted administration of synthetic desoxycorticosterone esters in animals. To this end, in July, 1939, two female dogs with carotid loops were selected for the experiment. One of these, S.E., was a normal animal, the other, N., one year before had had a unilateral nephrectomy, and the renal artery to the remaining kidney was slightly constricted by a Goldblatt clamp. The dogs were given the regular maintenance diet, containing some meat, and were injected subcutaneously with 20 mg of desoxycorticosterone acetate[2] in peanut oil daily for 70 days. In addition, two normal male dogs, maintained on a low potassium diet, have also been treated with daily injections of 25 mg of synthetic hormone. After 10 days of treatment in one instance and after 20 days of treatment in the other, both animals have developed changes similar to those shown by the other animals. The results may be summarized as follows:

(1) The changes in the blood constituents are shown in Table 1 and demonstrate a striking decrease in serum potassium, a slight increase in serum sodium, a slight decrease in serum protein and non-protein nitrogen and no definite change in blood sugar or serum calcium.

(2) All the dogs have shown curious periodic weakness with inability to stand or raise the head. The tendon reflexes have been active, and when the anima have been able to get on their feet they have held the limbs in marked hyperextension, but have usually be unable to raise their heads, apparently because flaccidity of the neck muscles. These bouts of paral sis, except for persistence of reflexes, have closely r sembled familial periodic paralysis in man, which also associated with marked decrease in serum pota sium. A number of the attacks of paralysis ha remitted spontaneously in the course of one to thr days, but others have been markedly alleviated in o half to eight hours apparently by the intravenous oral administration of potassium chloride. (Intrave ous dosage up to 1 gram in 2 per cent. solution a oral dosage up to 15 grams in one day). The admini tration of large doses of KCl appears to protect t animal from paralysis for one to three weeks.

(3) After several weeks of administration of sy thetic hormone the ingestion and excretion of wa have been definitely augmented. This "diabetes i sipidus" has been most apparent at those times wh varying degrees of paralysis have been present. T administration of KCl has further emphasized the di turbance of water regulation. The daily urine volu has frequently been in excess of 2.5 liters and has ev exceeded 4,000 cc.

(4) X-ray studies of the heart before and at the co clusion of hormone administration showed no increa in cardiac contour. The dogs did not receive lar amounts of salt in their diet in addition to hormo in contrast to the patients who developed cardiac di tation.

(5) Electrocardiographic studies made by Dr. W Williams showed irregular changes in the T waves which were perhaps most apparent when the seru potassium content was strikingly decreased.

(6) In the dogs with carotid loops there was maximal increase in arterial pressure of 45 mm and 2 mm Hg, respectively.

(7) Following the withdrawal of hormone all th abnormalities recorded disappeared in the course o

TABLE 1

Dog	Date	Na m.eq. per l.	K m.eq. per l.	Non-protein nitrogen mgm per 100 cc	Serum protein per cent.	Blood sugar mgm per 100 cc	Blood pressure mm Hg	Body weight Kgm
S.E.	Control 7/11	145.0	4.1	27	..	86	185	17.0
	Maximal effect	152.1	2.2	22	5.9	74	205	13.1
N.	Control 7/11	147.5	4.5	34	6.5	80	170	14.4
	Maximal effect	158.4	2.3	25	5.8	74	215	10.6
B.	Control 10/20	143.9	4.3	20	6.1	82	...	13.0
	Maximal effect	147.0	2.4	20	5.6	93	...	13.1
P.	Control 10/20	146.4	4.8	23	7.3	73	...	16.5
	Maximal effect	147.6	2.5	19	6.4	74	...	15.1

[1] From the Departments of Medicine and Neurology, College of Physicians and Surgeons, Columbia University, and the Presbyterian Hospital, New York.

[2] Supplied by Roche-Organon, Inc., Nutley, N. J.

three to four days and no manifestations of adrenal insufficiency appeared.

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THE ENCEPHALITOGENIC PROPERTY OF HERPES VIRUS[1]

MODIFICATIONS have recently been reported in the virulence of the viruses of human influenza,[2] vaccinia,[3,4] infectious bronchitis of fowls[5] and pseudorabies,[6,7] following cultivation on the chorio-allantois of chick embryos. This communication is to describe an increase in virulence for chick embryos and a reduction in virulence for rabbits which have occurred in a neurotropic strain of herpes simplex (HF, Rockefeller Institute) during 70 serial passages on the chorio-allantois of chick embryos. The technique of establishing and maintaining membranal strains of viruses has been described elsewhere.[8]

The original HF virus on membranes metastasized rarely to the heart and brain. After the twentieth passage it regularly induced metastatic lesions in the heart, liver, lungs, spleen and kidneys of embryos. Lesions in the heart, liver and spleen are grossly visible areas of necrosis. By subinoculation of membranes, embryonic blood was shown to contain virus at 24, 48, 72 and 96 hours. There was no localization of virus in the brain from the blood stream. The lethal effect of infection has increased so that at the 75th passage embryos rarely survived 96 hours, whereas at the tenth, most embryos survived infection 6 or 7 days.

As virulence for chick embryos has increased, it has diminished for the rabbit. After the 25th passage the membranal strain no longer induced a typical keratitis in rabbits. Fifteen rabbits scarified and inoculated on the cornea at intervals between the 25th and 65th membranal generations have shown only slight lacrimation, mild inflammation of conjunctiva without suppuration, no elevation of temperature and no symptoms of encephalitis. This is in contrast to an invariably fatal encephalitis which follows a suppurative keratitis induced by the original strain.

To determine whether or not this modified virus traveled along the fifth nerve from the cornea to the brain without causing encephalitis, two rabbits were inoculated on their right corneas: one with the 50th membranal generation, the other with HF. Corneal reactions typical of each strain developed. The rabbits were killed at 96 hours. The right Gasserian ganglion and brain at the entrance of the fifth nerve were removed from each animal and inoculated onto membranes. Herpes virus transmissible in series was recovered from both the Gasserian ganglion and the brain of the HF control rabbit. Virus could not be demonstrated grossly or microscopically on membranes inoculated with material from the rabbit with the modified virus. This experiment was repeated with the same result using rabbits inoculated with the 53rd generation virus and sacrificed at 96 hours and at 7 days. Material from the medulla of one of these rabbits inoculated intracerebrally into another rabbit induced no symptom.

These experiments led to the conclusion that the HF strain of herpes virus had lost its ability to invade the central nervous system following corneal inoculation in rabbits. A second series of passages through 30 generations over a period of 6 months has not induced a similar modification. Modification of the first strain was observed at the 25th generation 11 months after initiation of the chick strain. Whether the already established modification is a repeatable *Dauermodification* induced by prolonged passage of the virus on chick embryos or a suddenly appearing mutation remains to be determined.

To test the virulence of the modified strain following intracerebral inoculation, suspensions of HF virus (1st membranal generation) and the 62nd membranal generation in dilutions of 10^{-3}, 10^{-4} and 10^{-5} were inoculated intracerebrally into rabbits. All 3 rabbits receiving HF virus died within 5 days of herpetic encephalitis. Each rabbit receiving the modified virus had a remarkably delayed elevation of temperature. One (10^{-4}) is alive 60 days after inoculation; one (10^{-3}) died on the 20th day, and the other (10^{-5}) died on the 26th day.

Preliminary experiments indicate that corneal inoculation with the modified strain induces a stable degree of immunity to HF inoculated on the cornea.

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[1] Aided by a grant from the John and Mary R. Markle Foundation.

[2] F. M. Burnet, *Brit. Jour. Exp. Path.*, 17: 283, 1936.
[3] C. Levaditi, *et al.*, *Revue d'Immunologie*, 4: 481, 1938.
[4] L. Molina, *Zbl. f. Bakt., I. Orig.*, 139: 493, 1937.
[5] F. R. Beaudette (personal communication).
[6] F. M. Burnet, Dora Lush and A. V. Jackson, *Aust. Jour. Exp. Biol. and Med. Sc.*, 17: 35, 1939.
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THE CHEMICAL COMPOSITION OF SUCKLEYA SUCKLEYANA

FOLLOWING the discovery of hydrocyanic acid in *Suckleya suckleyana* during 1937, together with the experimental work which proved its toxicity to cattle, sheep, rabbits and guinea pigs, the etiology of many of the heretofore unexplained losses in cattle and sheep in eastern Colorado was explained.[1]

[1] Frank Thorp, Jr., A. W. Deem, H. D. Harrington and J. W. Tobiska, *Colo. Exp. Sta. Tech. Bul.*, 22: 1–19, 1937.

This seemed a desirable plant in which to study the factors influencing HCN formation. The chemical composition of *Suckleya suckleyana* and its relation to the toxic properties of the plant is an important physiological problem.[2]

Preliminary studies of the carbohydrate and nitrogen content of poison Suckleya showed the soluble carbohydrates to be chiefly reducing sugars which varied from one per cent. in seedlings to 2.5 per cent. in three-months-old plants. The sucrose content never exceeded 0.25 per cent. at any stage of development studied.

The starch content showed only moderate variation from early June to August.

Close relationship was found between the HCN and reducing sugar content. The HCN varied from a minimum of 0.018 per cent. at the time of minimum sugar content to a maximum of 0.240 per cent. when the sugar was highest.

Young plants contained a higher percentage of protein or colloidal nitrogen than old plants, but the older plants were higher in soluble nitrogen.

The marked reduction of protein nitrogen with advance of the season, accompanied by an equally rapid formation of HCN, is a behavior worthy of further investigation which may help to clarify some of the problems of nitrogen metabolism in plants. It is probable that following the exhaustion of available nitrates from the soil, synthesized proteins may be digested and the nitrogen constituent of the molecule then used in the formation of glucosides which yield HCN upon hydrolysis.

The data showed no accumulation of starch during the period of protein nitrogen diminution but rapid increase of reducing sugars. This relationship between the hexose sugars, colloidal nitrogen, soluble nitrogen and HCN suggests that the presence of available carbohydrates may stimulate the synthesis of the HCN—containing glucoside. The above relationship also suggests that this synthesis probably is not checked by limited nitrates, providing factors have been favorable for liberal protein formation in the early part of the season.

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EXPERIMENTAL CHRONIC CADMIUM POISONING[1]

CONTINUED feeding of albino rats with an adequate diet to which cadmium as the chloride had been added has been conducted in this laboratory for the purpose of studying the toxicity of chronically ingested cadmium. The details of this study will be reported elsewhere, but three symptoms of toxicity are so striking and of such importance as to justify a preliminary announcement in addition to the report presented at the twenty-third annual meeting of the Pacific Division of the American Association for the Advancement of Science.

The concentrations of cadmium added to the basic diet were 0.0031, 0.0062, 0.0125, 0.025 and 0.05 per cent. The symptoms of toxicity observed were bleaching of the enamel of the incisor teeth, anemia, and cardiac hypertrophy. The bleaching of the teeth is similar to, if not identical with, that produced by fluorides, and occurred on all dosage levels of cadmium. The degree of bleaching was proportional to the dosage. The anemia was likewise present on all dosage levels of cadmium, the severity increasing with the percentage of cadmium added to the diet. The cardiac hypertrophy was most evident on cadmium concentrations of 0.0062, 0.0125, and 0.025, and less evident on a concentration of 0.05 because the rats died before the hypertrophy could fully develop. Since the cardiac hypertrophy was not limited to the left ventricle, it is believed that the anemia rather than hypertension resulting from kidney damage was the causative factor.

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[1] Food Research Division Contribution No. 455.

[2] A paper presented at the Virginia meeting of the American Society of Plant Physiologists.

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